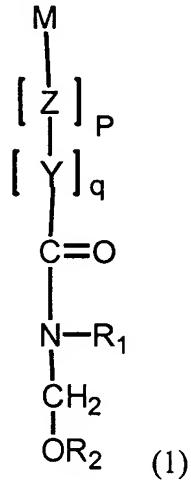
Claims

What is claimed is:

1. A negative photoresist composition, comprising:

(a) a radiation sensitive acid generator;

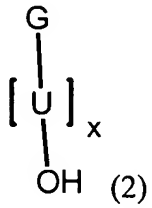
(b) a first polymer comprising a repeating unit from a first monomer (1), wherein the first monomer (1) has the structure:



(1)

and

(c) a second polymer comprising a repeating unit from a second monomer (2), wherein the second monomer (2) has the structure:



(2)

wherein G and M independently are polymerizable backbone moieties,

wherein Z is a linking moiety comprising one of -C(O)O-, -C(O)-, -OC(O)-, -O-C(O)-C(O)-O-,

wherein Y is one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons,

wherein U is one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons, -C(O)O-R, -C(O)-R, -OC(O)-R, -O-C(O)-C(O)-O-R, where R represents one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons,

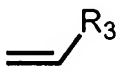
wherein p, q, and x are independently 0 or 1,

wherein R_1 and R_2 independently comprise one of hydrogen and a straight or branched alkyl group with 1 to 6 carbons,

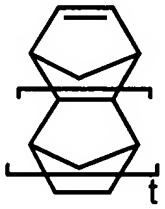
wherein the acid generator is adapted to generate an acid upon exposure to imaging radiation characterized by a wavelength, and

wherein the resist composition is soluble in an aqueous alkaline developer solution before exposure to the imaging radiation, and is insoluble in the aqueous alkaline developer solution after exposure to the imaging radiation.

2. The negative photoresist composition of claim 1, wherein the polymerizable backbone moiety, M and G, independently includes one of an acrylic structure and a cyclic olefinic structure, wherein the acrylic structure is:



wherein R_3 represents one of hydrogen, an alkyl group of 1 to 20 carbons, a semi- or perfluorinated alkyl group of 1 to 20 carbons, and CN, and wherein the cyclic olefinic structure is:



wherein t is an integer from 0 to 3.

3. The composition of claim 1, wherein the first polymer having the repeating unit from the first monomer (1) further comprises an aqueous base soluble moiety.

4. The composition of claim 3, wherein the aqueous base soluble moiety comprises one of a fluorosulfonamide, a carboxylic acid, and a fluoroalcohol.

5. The composition of claim 1, wherein the second polymer having the repeating unit from the second monomer (2) further comprises an aqueous base soluble moiety.

6. The composition of claim 5, wherein the aqueous base soluble moiety comprises one of a fluorosulfonamide, a carboxylic acid, and a fluoroalcohol.

7. The composition of claim 1, wherein the acid generator comprises at least one of 4-(1-butoxynaphthyl) tetrahydrothiophenium perfluorobutanesulfonate, triphenyl sulfonium perfluorobutanesulfonate, t-butylphenyl diphenyl sulfonium perfluorobutanesulfonate, 4-(1-butoxynaphthyl) tetrahydrothiophenium perfluorooctanesulfonate, triphenyl sulfonium perfluorooctanesulfonate, t-butylphenyl diphenyl sulfonium perfluorooctanesulfonate, di(t-butylphenyl) iodonium perfluorobutane sulfonate, di(t-butylphenyl) iodonium perfluorohexane sulfonate, di(t-butylphenyl) iodonium perfluoroethylcyclohexane sulfonate, di(t-buylphenyl)iodonium camphoresulfonate, and perfluorobutylsulfonyloxybicylo[2.2.1]-hept-5-ene-2,3-dicarboximide.

8. The negative photoresist composition of claim 1, further comprising at least one of a solvent and a quencher.

9. The negative photoresist composition of claim 8, wherein the solvent comprises at least one of

an ether, a glycol ether, an aromatic hydrocarbon, a ketone, an ester and combinations thereof.

10. The negative photoresist composition of claim 8, wherein the quencher is selected from the group consisting of aromatic amines, aliphatic amines and combinations thereof.

11. The composition of claim 8, wherein a weight of the first polymer is from about 0.1% to about 30% of the weight of the composition; a weight of the second polymer is from about 0.1% to about 30% of the composition; a weight of the solvent is from about 65% to about 99% of the weight of the composition; and wherein a weight of the acid generator is from about 0.5% to about 20% of the combined weight of the first and the second polymer.

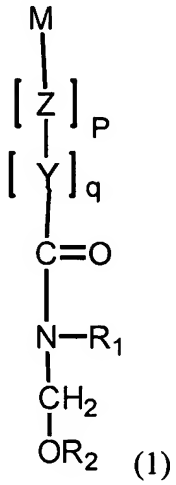
12. The composition of claim 8, wherein a weight of the first polymer is from about 0.2% to about 15% of the weight of the composition; a weight of the second polymer is from about 0.2% to about 15% of the composition; a weight of the solvent is from about 80% to about 99% of the weight of the composition; and wherein a weight of the acid generator is from about 0.5% to about 10% of the combined weight of the first and the second polymer.

13. A method of patterning a substrate, said method comprising the steps of:

(A) applying a negative photoresist composition to the substrate to form a resist layer on a material layer of the substrate and in direct mechanical contact with the material layer, said composition comprising:

(a) a radiation sensitive acid generator;

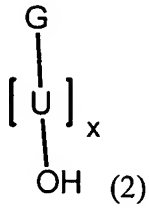
(b) a first polymer comprising a repeating unit from a first monomer (1), wherein the first monomer (1) has the structure:



(1)

and

(c) a second polymer comprising a repeating unit from a second monomer (2), wherein the second monomer (2) has the structure:



(2)

wherein G and M independently are polymerizable backbone moieties,

wherein Z is a linking moiety comprising one of -C(O)O-, -C(O)-, -OC(O)-, -O-C(O)-C(O)-O-,

wherein Y is one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons,

wherein U is one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons, -C(O)O-R, -C(O)-R, -OC(O)-R, -O-C(O)-C(O)-O-R, where R represents one of an alkylene group with 1 to 60 carbons, an arylene group with 6 to 60 carbons, a semi- or perfluorinated alkylene group with 1 to 60 carbons, a semi- or perfluorinated arylene group with 6 to 60 carbons,

wherein p, q, and x are independently 0 or 1,

wherein R_1, and R_2 independently comprise one of hydrogen and a straight or branched alkyl group with 1 to 6 carbons,

wherein the acid generator is adapted to generate an acid upon exposure to imaging radiation characterized by a wavelength, and

wherein the resist composition is soluble in an aqueous alkaline developer solution before exposure to the imaging radiation, and is insoluble in the aqueous alkaline developer solution after exposure to the imaging radiation.

(B) selectively exposing a first portion of the resist layer to imaging radiation characterized by a wavelength such that a second portion of the resist layer is not exposed to the radiation, wherein the first and second portions of the resist layer form a pattern in the resist layer, wherein the radiation causes the acid generator to generate acid in the first portion of the resist layer, wherein the acid facilitates a chemical reaction between the first polymer and the second polymer in the first portion of the resist layer such to generate a reaction product in the first portion of the resist layer, and wherein the reaction product is insoluble in the developer solution; and

(C) developing away the second portion of the resist layer by contacting the resist layer with the developer solution such that the second portion of the resist layer is replaced by voids in the resist layer.

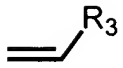
14. The method of claim 13, further comprising the steps of:

(d) transferring the pattern in the resist layer to the material layer, by etching into the material layer through the voids in the resist layer; and

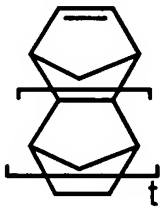
(e) after step (d), removing the resist layer.

15. The method of claim 13, wherein the wavelength is 193 nm or less.

16. The method of claim 13, wherein the polymerizable backbone moiety, M and G, independently includes one of an acrylic structure and a cyclic olefinic structure, wherein the acrylic structure is:



wherein R3 represents one of hydrogen, an alkyl group of 1 to 20 carbons, a semi- or perfluorinated alkyl group of 1 to 20 carbons, and CN, and wherein the cyclic olefinic structure is:



wherein t is an integer from 0 to 3.

17. The method of claim 13, wherein one of the first and second polymer further comprises a repeating unit formed from a monomer having an aqueous base soluble moiety.

18. The composition of claim 17, wherein the aqueous base soluble moiety comprises one of a fluorosulfonamide, a carboxylic acid, and a fluoroalcohol.

19. The method of claim 13, wherein the substrate comprises a semiconductor wafer.

20. The method of claim 13, said composition further comprising at least one of a solvent and quencher.